Social Determinants of Health Play a Role in Determining Health Utilization following Anterior or Lateral Lumbar Interbody Fusion.

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INTRODUCTION:

Social factors that impact both the physical and mental health of a person are known as Social Determinants of Health (SDH). Despite their importance to a patient's overall wellbeing, SDH have yet to be thoroughly investigated within spine surgery. Throughout medicine, there are many new machine learning (ML) techniques being used to gain insights into patient outcomes that would otherwise not be found. This study will employ ML techniques to understand relationships between SDH and postoperative health utilization in patients undergoing anterior or lateral lumbar interbody fusion (ALIF/LLIF).

METHODS:

Patients that underwent single or multi-level ALIF or LLIF at a multi-center academic health system between 2002 –2020 were acquired from the electronic medical record. More than 60 clinical variables including demographics, past medical and surgical history, postoperative complications, 30-day readmission, 90-day readmission, 90-day reoperation, and 1-year reoperation rates were included. The Geocodio platform, which retrieves geographic data from different sources including the US Census Bureau, was used to map addresses of patients to census tracts. Patients were assigned SDH characteristics by census tract using the Social Vulnerability Index (SVI). The SVI uses census data to determine social vulnerability by ranking each tract on 15 social factors (i.e. poverty, lack of vehicle access, crowded housing). The primary endpoint was a postoperative health utilization score, which was calculated as the sum of all ED or urgent care visits, invasive procedures (e.g. cardiac catheterization), non-routine testing (EMG), and non-routine imaging (CT, X-Ray, MRI) in the first 90 days after surgery. Several ML models were run using custom Python scripts and were validated by mean absolute error (MAE). The data was split into training/testing (80/20) sets. Validation was performed on withheld test data following optimization. The best performing model was determined by MAE; SHAP values were calculated for the best model to rank features by impact on output prediction.

RESULTS:

A total of 692 patients and 61 variables were included in the final sample. Average utilization score for patients was 7 (range 0-49), average BMI was 29.3, and 53% of the cohort was male. Of the 5 models ran, Random Forest performed best with an MAE of 2.63 (Figure 1). SHAP values showed that discharge to acute inpatient rehabilitation, age at surgery, and discharge to home/self-care were the most important variables in determining increased postoperative health utilization. (Figure 2). Socioeconomic status, minority status & language, and housing type & transportation were also found to be in the top 10 most predictive variables for high health utilization following ALIF or LLIF. When reviewing the top 3 predictors, the discharge disposition of acute inpatient rehabilitation and a higher age at surgery were positive predictors of increased postoperative health utilization while the discharge of home or self-care was a positive predictor of decreased postoperative health utilization.

DISCUSSION AND CONCLUSION:

Several SDH characteristics were found to be top predictors of postoperative health utilization following ALIF or LLIF including socioeconomic status, minority status & language, housing type & transportation, and overallSVI ranking. The results of this study suggest that even when considering relevant clinical variables, SDH have a strong predictive power on health utilization following anterior or lateral lumbar interbody fusion.

Figure 1 - Model Validation Metrics

Models	MAE
Random Forest	2.63
Support Vector Machine (Regression)	2.66
Gradient Boosted Regressor	2.68
XGBoost Regressor	2.78
Log Regressor	4.55

Figure 1 illustrates the Mean Absolute Error (MAE) metric for competing models.

Figure 2 - SHAP Plot